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HUMAN PARASITES

A

MANUAL

OF

REFERENCE TO ALL THE KNOWN SPECIES

OF

ENTOZOA AND ECTOZOA

WHICH (EXCLUDING THE MICROPHYTIC, CONFERVOID, AND SIMPLE SARCODIC ORGANISMS) ARE FOUND INFESTING MAN.

BY

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PREFACE.

THIS little work is based upon nine separate commmunications made to the Birmingham Natural History and Microscopical Society in 1878-79. The papers were read to the Society by Mr. W. R. Hughes, F.L.S., who also, on my behalf, exhibited numerous specimens and microscopic preparations sent for the purposes of illustration.

The papers were originally published in successive numbers of the 'Midland Naturalist,' and I have thought that their republication—with not unimportant additions—might prove serviceable, alike to the medical profession generally, to physicians, to students, and to naturalists.

74, PORTSDOWN ROAD,
MAIDA VALE, LONDON.

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PARASITES OF MAN.

INTRODUCTORY.

For the purpose held in view, an elaborate classification is unnecessary; therefore I arrange the various creatures, more or less commonly spoken of as parasites, under seven headings. Though not of equal value, either from the scientific or practical standpoint, these seven groups are perfectly distinct and natural.

I. Trematoda; flukes.
II. Cestoda; tapeworms.
III. Nematoda; roundworms and threadworms.
IV. Acanthocephala; thorn-headed worms.
V. Suctoria; leeches.
VI. Arachnida (parasitica); mites.
VII. Insecta (parasitica); insects.

Employing the term *parasite* in a far wider sense than that usually adopted, I have placed in this list many creatures not usually classed as parasites. The creatures in question supply instances of *partial*

parasitism, inasmuch as they derive sustenance from the host, although the duration of their visits may be but little more than instantaneous. The visits may be frequent or at prolonged intervals. In this view many irritating guests, such as fleas, flies, gnats, and mosquitoes, must be regarded as creatures possessed of parasitic habits.

It will be noticed that the Bacteria and their allies are excluded from this list. These microscopic organisms scarcely come within the province of the helminthologist, and moreover, their importance is such as to require separate and very special treatment. Some further reference to them will be found at the close of this manual.

I.—TREMATODA.

This group forms a natural order of animals. All the species that infest man are entozoal in habit, but some that attack marine animals are ectozoal. They are popularly called flukes, from the circumstance that the commoner species are flat, like the flukes or blades of an anchor. The old naturalists termed them trematodes, because they exhibit perforations or pores (*trema*, a pore) which we now recognise as suckers.

Flukes are planaria-like creatures, and usually of small size. The largest are not more than three inches in length, and the smallest are scarcely

visible to the naked eye. Sexually they are for the most part hermaphrodites, but in Bilharzia the sexes are separate. Most of the flukes have a simple divided intestine with two cæcal ends. In the genus Fasciola, which is thus distinct from Distoma, the intestinal tubes are finely branched or dendroid.

1. **Fasciola hepatica,** Linnæus.

Synonymy.—The common fluke — *Distoma hepaticum,* Retzius.

Size.—Half to three quarters of an inch in length.

Habitat.—Liver ducts, and also, occasionally, in abscesses beneath the skin.

Intermediate host.—Probably limited to the small freshwater snails called *Lymnæa truncatula* and *L. pereger.*

Experiments.—The most noteworthy are those conducted by Leuckart and the late Prof. Rolleston, independently. Those of Leuckart yielded positive results.

Remarks.—The common liver fluke of Ruminants has been found about twenty times in the human body.

Literature.—All standard works on Helminthology. See also especially Leuckart's recent memoir (Zur Entwicklungsgeschichte des Leberegels, in Archiv für Naturgesch.,

1882, S. 80), and likewise a short paper by Ercolani (Rend. d. Acad. d. Sc. d. Inst. di Bologna, 1881).

2. **Distoma lanceolatum,** Mehlis.

Syn.—*D. hepaticum,* Zeder and Rudolphi; *Dicrocœlium,* Dujardin and Weinland; *Fasciola,* Bloch; *Planaria,* Goeze.

Size.—One third of an inch in length.

Hab.—Infests the liver.

Larvæ.—Cercaria unknown. Free ciliated embryo globular.

Int. Host.—Not known. Probably a fresh-water snail.

Remarks.—Has thrice been found in man.

Lit.—All standard works, especially that of Leuckart.

3. **Distoma crassum,** Busk.

Syn.—*D. Buskii,* Lankester; *Dicrocœlium,* Weinland.

Size.—One to three inches in length.

Larvæ.—Unknown.

Int. Host.—Not known. Probably a species of oyster.

Hab.—Infests the duodenum.

Lit.—Cobbold; Synops. of the Distomidæ in Linn. Proceed., 1860; *idem.*; Obs. on the large fluke, with notes of two cases in which a Chinese missionary and his wife were the

victims; Linn. Soc. Proc., vol. xii (zool. div.;) and in the Veterinarian, 1876.

4. **Distoma sinense,** Cobbold.

Syn.—*D. spatulatum,* Leuckart.

Size.—Seven tenths of an inch in length.

Hab.—Infests the liver of Chinese.

Larvæ.—Unknown.

Int. Host.—Probably a freshwater mollusk.

Remarks.—Discovered by Professor McConnell.

Lit.—McConnell; Lancet for August, 1875; Macgregor; Glasgow Medical Journal for January, 1877.

5. **Distoma conjunctum,** Cobbold.

Syn.—None.

Size.—Three eighths of an inch in length.

Hab.—Infests the liver.

Larvæ.—Unknown.

Int. Hist.—Probably a small mollusk.

Remarks.—Originally found by me in an American fox (1858), and subsequently by Lewis in pariah dogs (1872), and afterwards by McConnell in man (1875).

Lit.—Cobbold; Synopsis (l. c.), 1859; Lewis; Gov. Rep., Calcutta, 1872; McConnell; Lancet, Feb., 1876.

6. **Distoma heterophyes,** Siebold.

Syn.—*Fasciola,* Moquin-Tandon; *Dicrocœlium,* Weinland.

Hab.—Infests the intestines.

Larvæ.—Unknown.

Int. Host.—Unknown.

Remarks.—Only once found. Discovered by Bilharz, at Cairo, 1851.

Lit.—All standard works, more particularly that of Leuckart.

7. **Distoma Ringeri,** Cobbold.

Syn.—None.

Size.—Nearly half an inch in length.

Hab.—Lungs.

Remarks.—Discovered by Dr. Ringer in North Formosa. The eggs also found by Dr. Manson in a Chinese.

Lit.—The Journal of the Quekett Microsc. Club, for August, 1880 (in a 'Note' by me appended to a paper by Dr. Manson). Also papers by Manson in Customs Gazette for April—September, 1880, and in 1881.

8. **Distoma ophthalmobium,** Diesing.

Syn.—*D. oculi humani,* Gescheidt; *D. lentis,* Von Ammon; *Dicrocœlium,* Weinland; *Monostoma,* Nordmann; *Festucaria,* Moquin-Tandon.

Remarks.—Several times found in the eye, but

as all the specimens were sexually immature, the species, as such, is of doubtful authenticity.

Lit.—All standard works.

9. **Tetrastoma renale,** Delle-Chiaje.

Syn.—None.

Remarks.—Supposed to infest the kidney. Discovered by Lucarelli in 1826.

Lit.—Delle-Chiaje; Elmintografia Umāna; 1833.

10. **Hexathyridium pinguicola,** Treutler.

Syn.—*Hexastoma,* Cuvier; *Linguatula,* Lamarck; *Polystoma,* Zeder; *Hexacotyle,* Blainville.

Remarks.—Only once detected. It was lodged in a small tumour of the size of a nut.

Lit.—Treutler; Obs. path. anat. ad helm. corp. humani, 1793.

11. **Hexathyridium venarum,** Treutler.

Syn.—As above.

Remarks.—Said to have been found on four occasions; by Treutler once, by Delle-Chiaje twice, and once by Follina. Infests the blood.

Lit.—As above; and in general treatises.

12. **Amphistoma hominis,** Lewis and McConnell.

Syn.—None.

Larvæ.—Unknown.

Hab.—Infests the intestine.

Remarks.—Twice found; in the first instance by Dr. O'Brien, of Gowatty; and by Dr. Curran and Dr. O'Brien together, afterwards.

Lit.—Lewis and McConnell; in Proceed. of the Asiatic Soc. of Bengal, 1876.

As regards the question of nomenclature, continental helminthologists no longer speak of the genera *Distoma, Tristoma, Polystoma, Sclerostoma,* and so forth; but, following Diesing, they prefer to convert the final Greek component into a true Latin syllable. Thus we have *Distomum, Polystomum, Sclerostomum,* and the like. Long habit has so fully familiarised us with the old plan of retaining the Greek termination unaltered that I confess to some reluctance in parting with the final component (*stoma*) although the form is not strictly classical. In helminthology there are probably fewer glaring errors of nomenclature than occur in other departments of Natural History Science. Nevertheless, I think Mr. Grove's criticism in the matter of the family term *Distomidæ* perfectly just.* Following the practice of the late Edward Forbes and others, I have frequently employed the names of *savans* for the purpose of forming new genera and species. Thus, by almost universal

* See 'Midland Naturalist' for May, 1878, p. 123.

consent, my genus *Bilharzia* has been adopted; its general acceptance being in part due, no doubt, to the fact that, as a generic term, it had priority over the various other titles severally proposed by Diesing, Weinland, and Moquin-Tandon.

13. **Bilharzia hæmatobia,** Cobbold.

Syn.—*Distoma hæmatobium,* Bilharz; *Gynæcophorus,* Diesing; *Thecosoma,* Moquin-Tandon; *Schistosoma,* Weinland.

Larvæ.—Cercaria unknown. Free ciliated embryo cone-shaped.

Remarks.—Infests the veins, and more particularly the portal system of blood-vessels. Frequent in Africa, especially Egypt, the Cape, and Natal; also the West Coast of Arabia. There is likewise evidence to show that it occurs in the Ile de Bourbon and the Mauritius, and probably also in Brazil. The grave disorder excited by this parasite is very prevalent amongst the natives whose habits are eminently favorable to its propagation. Among European residents the disease now commonly called endemic hæmaturia is decidedly on the increase. This has arisen chiefly on account of the continually increasing number of European residents. These have contracted the disorder by carelessly drinking unfiltered waters. Canal

and river water in the neighbourhood of villages must everywhere abound with the cercarian larvæ of this parasite. Whether the larvæ be free or encysted within the bodies of small mollusks can make very little difference. As obtains with other flukes, their ingestion will always be rapidly followed by the sexual maturity of the *Bilharzia*. Located within the visceral veins, the adult parasite, if present in any considerable numbers, will soon make its presence felt. If many worms exist, a violent hæmaturia may occur, without any warning. Experience has shown that although hæmaturia invariably accompanies the disorder, the bleeding—in cases where but few worms exist—may be so slight as to escape, not only the eye of the victim, but even also that of the medical attendant. From this it follows that the presence of the disease can only be certainly diagnosed by microscopic examinations of the urine. On many occasions I have detected the eggs of *Bilharzia* in urine which to the naked eye was perfectly clear. In every such instance blood-corpuscles were also present.

Lit.—Standard works, the details being chiefly from Bilharz and Griesinger. See also Sonsino; Sugli ematozoi come contributo

alla Fauna entoz. egiziana; Cairo, 1877; and in Arch. Gén. de Méd. for June, 1876. In my Lectures on Helminthology, delivered at the Middlesex Hospital, particulars of a case are given (Worms, 1872, p. 143), and the larvæ are figured in the work on Parasites (Lond. 1879, p. 40). See also J. Chatin in the Ann. des Sciences Nat., 1881, and especially Dr. Guillemard's recent brochure on the Endemic Hæmaturia of Hot Climates, London, 1882.

CESTODA.

Cestodes differ essentially from the Trematodes in that the so-called species are multiple in character. What is spoken of as a tapeworm is not *one* creature, but in reality a multitude of organisms, or zooids, arranged in single file. The head itself is merely the topmost zooid, modified in shape, and armed with sucking disks, so as to form a means of anchorage for the whole colony. This cephalic holdfast, as it might be called, is in some sense the counterpart of what we see not only in the fixed polypes, but also in the free compound Medusæ. In carrying out the analogy it must not be forgotten that the solid hydrorhiza of an ordinary Sertularian

polype was once a free-swimming ciliated larva, whilst the inflated end of the cœnosarc forming the float of Physalus had a similar origin. In all these cases the metamorphosis of a larva, either directly or indirectly, secures the formation of an organ of anchorage or support involving the welfare of the entire chain or colony of zooids. It is sufficient to insist upon the strict analogy of these phenomena without suggesting questions of homology.

An ordinary human tapeworm consists of about twelve hundred zooids or proglottides. Each proglottis is bisexual, and when mature is capable of holding, according to Leuckart, about 35,000 eggs. The entire colony of twelve hundred zooids is renewed every three months, and thus it follows that the amount of egg-dispersion annually resulting from a single beef tapeworm cannot be less that twelve millions. In all probability this calculation is very much below the mark, seing that the 35,000 impregnated germs capable of existing in the fully mature proglottis, at a given period, do not by any means serve to fix the limit of the possibilities of egg-formation within the proglottis. Of course, as compared with the quantity of germs distributed, the number that survive and come to perfection, as Tæniæ, must be infinitesimally small.

An exhaustive knowledge of the development of the Cestodes is given in the recent beautiful work of Hein (Die Parasitären Krankheiten des Menschen,

vol. i, 1882), to which the reader is referred for details and illustrations.

14. **Tænia mediocanellata,** Küchenmeister.

Syn.—*T. saginata,* Goeze; *T. dentata,* Nicolai; *T. inermis,* Moquin-Tandon; *Tæniorhynchus,* Weinland.

Larva.—A simple Scolex, known as the beef measle (*Cysticercus bovis,* Cobbold).

Int. Host.—The ox (*Bos taurus*) and all its varieties. The cattle of the Punjab are largely infested. As many as 300 Cysticerci have been counted by Dr. Joseph Fleming in a pound of flesh taken from the psoas muscles.

Remarks.—This cestode, often called the beef tapeworm, is much more prevalent than the pork tapeworm. Taking all classes of infested persons together it probably occurs in about ninety per cent. Of the cases of tapeworm coming under my own observation not less than ninety-six per cent. have been of this species. The supposition that armed and unarmed Tæniæ are merely modifications due to differences of habitation is quite untenable. M. Mégnin's deductions are not warranted by the facts adduced in support of his theory.

Experiments on animals.—The larvæ have been

reared in cattle by Leuckart, Mosler, Cobbold and Simonds, Probstmayer, Zurn, St. Cyr, Perroncito, and MM. Masse and Pourquier. The measles are usually found in the voluntary muscles, in the heart, and in the connective tissues. I have, however, twice found them in the liver and once in the lungs.

Experiments on man.—Dr. Oliver reared the adult tapeworm in a Mahommedan syce and in a Hindoo boy. Professor Perroncito recently persuaded Dr. Ragni, Mr. Gemelli, and others to swallow beef-measles which had been subjected to varying degrees of temperature (45°—47° C.). One student thus reared a mature Tænia within himself in fifty-four days.

Lit.—Standard works; especially that of Leuckart. See also my Tapeworms (3rd edit.), Longmans, 1874. Perroncito; Experamenti, &c., Lo Studente Vet., (Parma, 1876, p. 146), and various papers in the Veterinarian (July and December, 1877). Masse et Pourquier in Montpellier Med. Journal Mensuel de Médicine, 1876. See also Heller (quoted below). In reference to M. Mégnin's peculiar views respecting the metamorphoses of Tænia (published in Comptes Rendus, 1879, in Robin's Journal,

in Revue für Thierheilkunde, and elsewhere) I can only here call attention to the remarks by M. Crinon in La France Médicale for September 13th, 1879, and M. Mégnin's reply in the same periodical for October 11th, 1879. See also several papers by M. Moniez, Comptes Rendus, 1877—79.

15. **Tænia solium,** Linnæus.

Syn.—*T. cucurbitina,* Pallas; *T. humana armata,* Brera; *T. lata,* Pruner; *T. vulgaris,* Werner.

Larva.—Simple scolex; familiarly known as the pork-measle (*Cysticercus cellulosæ* of authors).

Int. Host.—The hog (*Sus scrofa*), both in the wild and domesticated state. As this measle also develops within the human body, man may himself become an intermediate bearer, and, by an act of canabalism on the part of another man, prove a source of tapeworm-infection.

Remarks.—This cestode, though usually regarded as the common tapeworm, is comparatively rare in England. It is chiefly found amongst the poor, who are large consumers of pork which is often imperfectly cooked. In Iceland the pork tapeworm is rather more common than the beef tapeworm.

Exp.—Pork measles have been reared in the pig

by Van Beneden, Haubner, Küchenmeister, Leuckart, Gerlach, and others. Küchenmeister likewise reared both mature and immature Tæniæ of this species in condemned criminals. Under Leuckart's auspices, several young persons voluntarily allowed themselves to become infested by swallowing fresh and living pork measles.

Lit.—The works of Leuckart and Küchenmeister; and also, more particularly, Heller's Darmschmarotzer, in Von Ziemssen's Handbuch (Bd. vii, S. 601), and in the Anglo-American edition. Davaine, Les Cestoïdes, in Dict. Encyclop. des Sciences Méd. (new edit.). Also my work on Parasites (p. 84).

16. **Tænia tenella,** Cobbold.

Syn.—None; but Pruner gave the title *T. tenella*) to a worm which was probably *T. solium.*

Larva.—At present unknown, but conjectured to be the mutton-measle (*Cysticercus ovis,* Cobbold).

Int. Host.—Probably the sheep (*Ovis aries*), which is occasionally infested by armed Cysticerci.

Remarks.—On five separate occasions I have observed measles in joints of mutton brought to my own table. I have also in practice

several times encountered a very slender tapeworm in man, which is not improbably the adult representative of this Cysticercus. Examples of the mutton-measle have also been seen by Prof. Heisch, Dr. (now Sir John) Kirk, and Dr. Maddox.

Exp.—The only breeding experiment performed by me with this slender tapeworm was on a lamb (1872). The result was negative.

Lit.—Cobbold; Tapeworms (3rd edit.); and in Supp. to Entozoa, 1869 (p. 27). Maddox, On an Entozoon, with ova, found encysted in the muscles of a sheep; Nature, May 15th, 1873; Month. Micr. Journ., June, 1873; Lond. Med. Record, Aug. 6th, 1873.

17. **Tænia lophosoma,** Cobbold.

Syn.—None. A malformed tapeworm (Heller).

Larva.—Unknown.

Remarks.—This a good species, notwithstanding the criticism that has been bestowed upon my determinations. It is quite distinct from Küchenmeister's variety from the Cape of Good Hope. The reproductive papillæ are placed all on one side of the strobile throughout.

Lit.— Cobbold; Tapeworms. Davaine, Les Cestoïdes, (l. c. p. 573); Heller, (l. c. S. 594).

18. **Tænia nana,** Siebold.

Syn.—*T. ægyptiaca,* Bilharz; *Diplacanthus,* Weinland.

Larva.—Unknown.

Int. Host.—Probably an insect (Leuckart).

Remarks.—This little tapeworm has only once been found. It was discovered by Bilharz in an Egyptian boy in very large numbers. The finest examples did not quite reach an inch in length.

19. **Tænia madagascariensis,** Davaine.

Syn.—None.

Larva.—Unknown.

Remarks.—Discovered by Dr. Grenet (at Mayotte, Comores) to have passed from two young children. The reproductive pores are uniserially disposed, as in *T. lophosoma.*

Lit.—Davaine; Art. Les Cestoïdes (l. c. p. 577 *et seq.*).

20. **Tænia elliptica,** Batsch.

Syn.—*T. canina,* Pallas; *T. cateniformis,* Rudolphi; *T. cucumerina,* Bloch; *Dipylidium,* Leuckart.

Larva.—A louse measle (*Cysticercus Tæniæ ellipticæ*).

Int. Host.—Lice of the dog and cat (*Trichodectes latus* and *Trich. subrostratus*).

Remarks.—Most helmínthologists believe that this cestode is identical with the cucumerine tapeworm of the dog. At best it is a mere variety.

Lit.—Melnikow; in Archiv für Naturgeschichte, 1869; and in Recueil de Méd. Vét., 1871.

21. **Tænia flavopuncta,** Weinland.

Syn.—*T. flavomaculata,* Molin; *Hymenolepis,* Weinland.

Larva.—Unknown.

Remarks.—This is a small worm which has only been once seen. It was obtained by Dr. Palmer, in America, from an infant. As in *T. lophosoma* and *T. madagascariensis,* the reproductive papillæ are uniserially arranged.

Lit.—Weinland; Tapeworms of Man, 1858, and in his Beschreibung zweier neuer Tænioiden aus dem Menschen, 1861.

22. **Tænia abietina,** Weinland.

Remarks.—As observed in my recent work (Parasites, p. 102), this worm is probably a variety of *Tænia mediocanellata.*

Lit.—As above.

The *Bothriocephali* are readily distinguished from ordinary tapeworms, not only by the absence of true suckers on the head, but also by the circumstance that the reproductive openings are placed on

the ventral aspect of the segments (proglottides) in the median line. The classification of the cestodes, as a whole, requires revision, but no zoological arrangement will stand that is not based on the examination of a large number of types. It may be that the out-of-the-way types are difficult to get at and comparatively rare; nevertheless it is just these aberrant types that are wanting to the systematist. The hard-and-fast line drawn between the armed tapeworms and the unarmed forms cannot be allowed to remain, since rudimentary hooklets have been found attached to the margin of the supplementary suckerlet or central disk of the beef tapeworm. Of course, as a matter of mere convenience it is useful to separate the hooked and hookless Tæniæ, but the separation is not fitting as a primary basis of classification. In like manner the snouted or proboscis-bearing tapeworms (*Rhynchotæniada*), considered as altogether distinct from the tapeworms that do not possess any proboscis or rostellum (*Arhynchotæniada*), cannot be accepted. Of far more value is the proposal that we should divide the tapeworms into two suborders, based on the characters of the egg-shell. This originated with Dr. Weinland, of Frankfort. Thus, for the thick or hard-shelled tapeworms he proposed the term *Scleroleptidota*, and for thin-shelled forms the term *Malacoleptidota*. The eggs of the former require the action of the gastric juice of verte-

brates to dissolve their shells, whilst the eggs of the latter readily hatch within the stomach of evertebrated animals, such as mollusks and insects. Quite recently, astonishment was expressed (in the pages of a scientific journal) that herbivorous animals should suffer from the presence of tapeworm. It was evidently unknown that the larvæ of certain tapeworms are found in many other kinds of food than meat.

In reference to the temperature necessary to destroy the eggs of tapeworms, it is generally understood that the ova of the *Scleroleptidota* can effectually resist the action of ice and frost. As to the limited powers of resistance of heat possessed by Cysticerci we are now well informed, but I can only refer to Professor Perroncito's experiments and to the inquiries of Lewis, Tommasi, Pellizzari, Giacomini, myself, and others, as set forth in a series of articles published in the London Medical Record for 1874. Professor Pellizzari found that measles died at a temperature of 60° centigrade (*i.e.* 140° Fahr.). According to Lewis, exposure of the parasites for five minutes to the same degree of heat, or even to 135° Fahr., renders the life of these parasites absolutely extinct. Later researches by Perroncito fix the degree at a much lower level (122° Fahr.).

23. **Bothriocephalus latus,** Bremser.

Syn.—*Tænia lata,* Linn; *T. grisea,* Pallas; *Dibothrium latum,* Diesing.

Int. Host.—The higher larvæ are supposed to reside in fishes, especially salmon and trout. According to Dr. Fock, of Utrecht, the bleak (which is much eaten by Jews in Holland who suffer from this tapeworm) is possibly the intermediate bearer; but with more show of reason M. Duchamp makes it probable that our Bothriocephalus is the sexually mature state of *Ligula nodosa.* This cestode is common in the trout.

Larva.—Scolex unknown; proscolex, or six-hooked embryo, furnished with long and closely-set cilia.

Remarks.—This worm is abundant in Switzerland, Russia, Sweden, and the north-east of Germany. It occasionally occurs in Ireland, but very rarely in England.

Exp.—All attempts to rear this worm have failed, although Dr. Knoch, of St. Petersburg, supposed he had succeeded by the administration of the eggs to dogs.

Lit.—Leuckart (l. c.); Heller (l. c.); Knoch, Die Naturgeschichte des breiten Bandwurms, 1862; Sömmer and Landois, Beiträge zur Anat., &c., in Sieb. and Köll. Zeitschrift, 1872; Bötcher, in Virchow's Archiv, 1864.

Perroncito, in Osservatore for October, 1880; Duchamp, Resp. Anat. et Physiol. sur les Ligules, Paris, 1876. See also F. Kiesling's recent paper on Schistocephalus and Ligula in Troschel's Archiv for 1882, S. 241 *et. seq.*

24. **Bothriocephalus cordatus,** Leuckart.

Syn.—*T. vulgaris,* Linn., Pallas.

Larva.—Unknown.

Int. Host.—Probably marine fishes.

Remarks.—This species is about a foot in length, and is very abundant in the dogs of North Greenland. It occasionally infests man. The head is somewhat heart-shaped, and set on to the strobile without any neck or narrow segmentation intervening.

Lit.—Leuckart, Die mensch. Par., Bd. i, S. 437, 1863.

25. **Bothriocephalus cristatus,** Davaine.

Syn.—None.

Larva.—Unknown.

Remarks.—This species is of moderate length (8 ft. to 10 ft.), and comparatively narrow. It is distinguished by the presence of a crest-like rostellum. It has twice been found in France. The Westminster Hospital Museum contains some tapeworms probably referable to this species.

Lit.—Davaine, Les Cestoïdes, Dictionnaire Enclyclopédique des Sciences Médicales (p. 599), 1874.

Although the last-named species closes the list of human tapeworms, properly so called, yet no record of the cestodes of man can be considered complete without taking into account the occurrence of hydatids. These structures, often spoken of as bladderworms, form, as is now well known, the scolex condition of a minute tapeworm which lives in the dog (*Tænia echinococcus*). From a sanitary and professional point of view this parasite is of more importance than all the others put together. Every experienced surgeon has to deal with instances of its occurrence in important organs, and probably not less than four hundred persons perish in the United Kingdom every year from this worm. In Australia and in Iceland the echinococcus disease is excessively fatal to man. The parasite is also scarcely less frequent amongst animals, although in these bearers its presence is only rarely attended with fatal consequences. Zoologically and morphologically the common hydatid is of great interest. Whilst the sexually mature worm supplies us with a tapeworm altogether unique (both as regards its size and the small number of its proglottides), the larva, in the character of an hydatid, presents us with a type of

polycephalous bladderworm which likewise has no parallel. The hydatid furnishes us also with a curious illustration of the possibilities of tapeworm multiplication from a single germ. Starting with the postulate that the sum total of the products of a single impregnated germ or ovum fairly represents the "individual" (zoologically, so to say), we find that whilst, on the one hand, the egg of any ordinary tapeworm begets only one Tænia, the egg of the hydatid tapeworm is capable of producing, under favorable circumstances, several thousand tapeworms. To appreciate this truth, it is only necessary to observe that the six-hooked embryo becomes one hydatid. This maternal bladderworm may by proliferation beget daughter and granddaughter hydatids, all of which in their turn may give rise to the formation of echinococcus heads in their interior. Separately these so-called heads represent as many tapeworms, and collectively they amount to many thousands. Thus, when a dog or wolf swallows the polycephalous hydatid and its offspring, all the heads of the colony will become converted into sexually mature tapeworms in the intestine of the new host. The zoological individual, therefore, will comprise not merely one tapeworm, but a multitude of tapeworms. In other words, whilst the egg of an ordinary tapeworm like *Tænia mediocanellata* supplies a single colony or strobile of 1200 joints (proglottides or zooids),

the egg of the little *Tænia echinococcus* supplies several thousand colonies or strobiles, each of which is made up of three segments and a head. This singular mode of tapeworm multiplication is also witnessed, though in a much less degree, in other forms springing from polycephalous bladder-worms.

26. **Echinococcus hominis,** Rudolphi.

Syn.—*E. veterinorum,* Bremser, Gurlt, &c.; *E. scoliciparíens* and *E. altriciparíens,* Küchenmeister; *E. polymorphus,* Diesing; *Acephalocystis,* Laennec, John Hunter, Owen, &c.; *Polycephalus,* Goeze; *Hydatis,* Lüdersen; *Hydatigena,* Batsch; *Vesicaria,* Schrank.

Adult State.—*Tænia echinococcus,* Von Siebold.

Ultimate Host.—Dog and wolf.

Remarks.—Forms three well marked types of hydatid growth, known to pathologists as exogenous, endogenous, and multilocular varieties (*E. multilocularis,* Virchow). The liver is the organ most frequented. Thus, in 327 cases collected by myself, 373 by Davaine, and 983 by Neisser, giving a total of 1683 cases, the average of liver cases was very nearly 46 per cent. Hydatids probably prove fatal in 25 per cent. of all the persons attacked. In Iceland they are the cause of one sixth of the annual mortality.

Lit.—All standard works on helminthology, especially those of Leuckart and Davaine. The best monograph is that of Dr. Albert Neisser (Die Echinococcen-Krankheit; Berlin, 1877). Recent additions to the purely surgical literature of hydatids are far too numerous for separate quotation; but in this connection practitioners will do well to consult the Australian Medical Journal, which contains interesting papers by Drs. H. S. Wood, W. Thomas, W. Snowball, and others.

27. **Cysticercus** (*telæ*) **cellulosæ**, Rud.

Although the common hog measle is merely the bladderworm state of the pork tapeworm (already considered, &c.—No. 15), yet in any catalogue of human parasites it should be separately noticed as a perfectly independent entozoon. Its occurrence in the brain is usually, but not necessarily, fatal to the human host.

Lit.—Same as *Tænia solium*.

28. **Cysticercus racemosus**, Zenker.

This form of measle, if not specifically distinct from the ordinary *Cysticercus cellulosæ*, must at least be allowed to stand apart as a separate variety.

Lit.—Zenker, Ueber den Cysticercus racemosus des Gehirns, in J. Henle's 'Beiträge' (&c.), Bonn, for April, S. 119, 1882.

29. **Cysticercus tenuicollis,** Rud.

There appears to be but one genuine instance of the occurrence of this larval tapeworm in the human body; unless, as is probable, the large Cysticercus preserved in King's College Museum be also referable to this scolex. This slender-necked measle is the juvenile condition of the *Tænia marginata* of the dog.

Although the above twenty-nine parasites may be fairly regarded as exhausting the list of human trematodes and cestodes, yet several other species of tapeworm have from time to time been indicated on what are probably insufficient grounds. In this doubtful category I place Weinland's *Tænia megaloön,* and also another tapeworm which Dr. Ransome concludes to exist from the diagnostic evidence furnished by the finding and examination of a particular form of cestode ovum. In Weinland's case both loose proglottides and eggs were examined; consequently the strobile may turn out to represent a good species. He figures the ova in Zoolog. Garten Frankf., 1861, S. 118. Respecting a variety of manifestly spurious entozoa, such as Frédault's *Trachelocampula* and the like, nothing need be added.

NEMATODA.

The nematoid parasites are probably better known than any other helminths. This arises partly on account of the excessive frequency of the little threadworm (*Oxyuris*), partly from the circumstance that the large roundworm (*Ascaris*) bears a marked resemblance to the common lobworm of our gardens (*Lumbricus*), and partly, or perhaps chiefly, because the spiral fleshworm (*Trichina*) plays an important *rôle* in the production of epidemic disease (*Trichinosis*). Endless mistakes have arisen from the error of confounding parasitic roundworms with earthworms. The mischievous character of unscientific or inexact knowledge may be illustrated by the fact that I have known nervous persons so seriously alarmed at the appearance of lumbricoid entozoa that they have regarded their presence as an omen of approaching dissolution. I have even known a spurious nematoid to be dreaded as "the worm that dieth not." It is very important that correct views should be entertained respecting the nature and sources of the various members of this group of parasites. Nothing is more absurd than the popular notion that nematoid entozoa, especially threadworms (*Oxyurides*), arise or make their appearance in consequence of an impoverished state or chachexia of the body of the host. This ridicu-

lous conception, which is as old as the hills, is ever and anon re-asserted with all the pride and confidence which should only be displayed when any real and valuable discovery has to be announced. The notion, as it now stands, is a feeble remnant of the theory of equivocal generation. For the establishment of the truth of this theory the spontaneous generationists always pointed, triumphantly as they supposed, to the mode of origination of the entozoa. The truth is that neither threadworms nor helminths of any other kind arise from diseased conditions. They often produce constitutional disturbance in their victims, this bad effect being misinterpreted as a cause of the appearance of the entozoa themselves. A healthy person is just as likely—nay, he is even more likely, to entertain parasites than a feeble person. True, the strong host may suffer comparatively little, whilst the weak host succumbs to his guests. The host is the entozoon's native territory. What our native island is to us our bodies are to parasites. To attack, to invade, to infest, is their legitimate prerogative; and for this end it must be admitted that their organisation is admirably adapted. To be sure, it is equally our perogative to refuse the would-be guests admission, but any method of resistance likely to prove effectual must be based upon scientific conclusions resulting for the most part from experimental research. Ancient dogmas and

preconceived opinions too often operate to obscure the mental vision, and thus prevent the adoption of measures calculated to check not a few of the many evils to which our common flesh is heir.

30. **Trichina spiralis**, Owen.

Syn.—*Pseudalius trichina*, Davaine.

Larvæ.—Commonly spoken of as muscle-trichinæ, capsuled or encysted trichinæ, and fleshworms.

Int. Host.—All warm-blooded animals, especially mammals, and of these the hog and rat more especially. Man himself may become an intermediate bearer.

Exp.—These are of two kinds, as referring either to the larvæ or to the full-grown worm. The larvæ were first reared by Herbst (1850), and the adult worms by Virchow (1859). These results were subsequently verified and extended by Leuckart, Claus, Küchenmeister, Pagenstecher, and many others abroad; and they were confirmed by Thudichum and myself in this country. The worm-feedings administered by Professor Simonds and myself infected four dogs, two cats, one pig, one guinea-pig, one hedgehog, and probably several rats which, unfortunately, made their escape.

Remarks.—The original discovery of the cap-

sules, as "little bodies" or "concretions," was made either by Tiedemannn (1822) or by Peacock (1828). Their parasitic character was first indicated by Hilton (1833). The actual discovery of the worm was made by Paget (1834), and it was afterwards scientifically named and described by Owen (1835). The most brilliant discovery of all was that of Zenker (1860). He it was who demonstrated that migrating Trichinæ were productive of disease (Trichinosis). Finally, the most complete account of the migrations and structural changes undergone by the worm is due to Leuckart.

Lit.—Althaus, Essay on Trichinosis, 1864; Boehler, Die Trichinenkrankheit in Plauen, 1863; Gerlach, Die Trichinen, 1866; Cobbold, On the History of the Discovery of *Trichina spiralis* in Supp. to Entozoa, 1869; *idem*, Experiments, Proceedings Linn. Soc., 1867; Leuckart, Uutersuchungen ueber *T. spiralis*, 1866; Luschka, Zeitschrift für Wissensch. Zool., 1851; Owen, in Zool. Soc. Trans., 1835; Pagenstecher (and Fuchs), Die Trichinen, 1868; Thudichum, Government Report On Parasitic Diseases, &c., 1865; Virchow, Darstellung der Lehre von den Trichinen (u. s. w.,), 1864; Zenker, Zur Lehre von der Trichinenkrankheit, in

Deutsches Archiv f. Klin. Med., Bd. viii, and in Virchow's Archiv, 1855. Amongst the later contributions I must particularise Dr. Glazier's exhaustive Report on Trichinæ and Trichinosis (Washington, 1881); also Laboulbène's memoir (Bull. de l'Acad. de Méd.), February, 1881; also Mégnin's finely illustrated paper (Sur de petits helminthes agames enkystés qui peuvent être confondus et qui l'ont été avec la *Trichina spiralis*) in Bull. de la Soc. Zool. de France; and my popular lecture first published in the Sanitary Record, and subsequently in L'Italia Agricola for December, 1880 (Trichinosis and the Dangers arising from the Consumption of Animal Food). This also appeared in the Osservatore Gazetta delle Cliniche of Turin. See likewise Dr. E. C. Wendt's paper on Chronic Affections of the Muscles following Trichinosis, in the Medical Record of New York, for October 4th, 1879, p. 319.

31. **Trichocephalus dispar,** Rudolphi.

Syn.—*T. hominis,* Goeze; *Trichuris,* Buttner; *Ascaris trichiura,* Linn.

Larvæ.—Küchenmeister and Meissner supposed that Trichinæ were the young of Trichocephalus. This view was controverted by Virchow.

Int. Host.—Unknown. The experiments of Davaine render it probable that infection takes place in a direct manner some time after the eggs have escaped the human bearer.

Exp.—Davaine finds that dryness does not destroy the ova, and that a period of six months elapses before embryonic formation commences. The embryos will live for many years in the free eggs.

Remarks.—The Dublin helminthologist, Bellingham, was one of the earliest to attest the frequency of the whipworm in Great Britain. He found it in eighty-one out of ninety post-mortem examinations. Davaine has stated that not less than half the Parisians are victimised by this worm. Mr. Cooper, of Greenwich, found it present in eleven out of sixteen autopsies. This worm and its congener (infesting ruminants) have been anatomised by Dujardin, von Siebold, Mayer, Eberth, Erasmus Wilson, Busk, Bastian, and myself.

Lit.—Bastian, in Philos. Trans., 1866; Bellingham, in Dublin Journal, 1838; Busk, in Annals Nat. Hist., 1841; Cobbold, in Linn. Trans., 1859; Eberth, in Sieb. and Köll. Zeitschr., 1860; Mayer, *ibid.*, 1858-60; Siebold, in Wiegm. Archiv, 1845; Wilson, E.,

in the Veterinary Record and Transactions, 1846.

32. **Filaria Bancrofti,** Cobbold.

Syn. — *Filaria sanguinis hominis,* Lewis; *Filaria cystica,* Dobson; *F. Wuchereri,* Cobbold (conditionally); *Filaris sanguinis,* Bancroft; *Trichina cystica,* Salisbury.

Larvæ.—The synonyms above given originally referred to the embryonic condition; but the embryos have also been described as nematoid hæmatozoa, micro-filariæ, hæmatochylous helminths (Corre), worms of Guadeloupe (Crevaux), worms of Brazil (Wucherer), probable embryos of Strongilidæ (Leuckart), anguillula-like microscopic nematodes (Sonsino). Free microscopic nematoids, closely resembling these larvæ, have been found in the potable waters of Rio (agua da Carioca) by Dr. Magalhães. Their genetic relation with *F. Bancrofti,* however, is very doubtful.

Int. Host.—Dr. Bancroft originally suggested, and Dr. Manson actually discovered, that the hæmatozoal micro-filariæ were passively transferred to the stomach of mosquitoes. Dr. Manson has described the transformations undergone by the larvæ within these insects.

Exp. — Dr. Manson induced an infected Chinese to sleep in a mosquito-house, and thus procured on the following morning a

number of mosquitoes that had gorged themselves with blood containing human filariæ. A relatively far greater proportion of hæmatozoa existed in a drop of the insucked blood taken from the mosquito than in a drop taken from the Chinese in a direct manner. The construction of the proboscis of the female mosquito seems to be especially adapted for drawing the worms out of the capillary blood-vessels.

Remarks.—There is every reason to believe that the microscopic hæmatozoa of man are capable of producing a variety of diseases, some of which are endemic. In this category must be placed certain forms of hæmaturia, chyluria, varix, elephantiasis, and other lymphoid affections, and likewise the African cutaneous disorder termed craw-craw, *Filariasis dermathemica,* O'Neill. The whole of them have been characterised as constituting varieties of one disorder which Dr. Bourel-Roncière terms Wucherer's helminthiasis.

Epochs of Discovery.—The adult worm, which measures three and a half inches in length, was first discovered by Bancroft, and subsequently described by myself. It was afterwards found by Lewis, whose description was actually published before Bancroft's specimens reached England. Subsequently our

"finds" were verified by Dr. Araujo and by Dr. F. dos Santos. The larvæ were first discovered by Wucherer, whose observations were afterwards verified and extended by Salisbury, by myself, and especially by Lewis. The discovery of *Filaria sanguinis hominis*, that is, of the larval *F. Bancrofti*, as a true blood parasite was made by Dr. T. R. Lewis in India; but in consequence of Wucherer's prior find of the larvæ in urine, the young worm is sometimes called *Filaria Wuchereri*. We have, in short, five important epochs of filarial discovery. The *first* relates to the detection of embryonic filariæ in the excretory fluids in 1866. The *second* fixes the period of Lewis's great discovery in 1872. The *third* to Bancroft's "find" of the mature parasite in 1876. The *fourth* relates to Manson's announcement that the mosquito forms the intermediary host, within whose body the higher larval stages of the parasite are reared. The *fifth*, and crowning discovery of all, has made known to us the fact that the microscopic larvæ not only undertake, but, under normal conditions, regularly accomplish daily and nightly wanderings to and from the circulation. This phenomenon on the part of the hæmatozoa is termed "filarial periodicity," its discovery being also

exclusively due to Manson. The existence of this law of periodicity has been verified by the researches of Dr. Wykeham Myers at Formosa, and by Dr. Stephen Mackenzie in England. It has also been shown by Mackenzie that the phenomenon of periodicity may be reversed by causing the victim or filarious patient to sleep during the day instead of during the night. This seems to lend support to the view advocated by Dr. J. Mortimer Granville, who thinks that the phenomenon is immediately due to the conditions of the circulation and chyle currents that accompany sleep.

Lit.—Wucherer, in Gaz. Med. da Bahia, Dec., 1868, and Sept., 1869, and in Hallier's Zeitschrift, 1869, and in Arch. de Méd. Navale, 1870; Salisbury, in Hay's Amer. Journ., 1868; Cobbold, in Brit. Med. Journ., July, 1872, and in Lectures on Helminth., 1872; in B. M. J., June, 1876; in the Lancet for July and Oct., 1877; in Reports of the Proceedings of the Linnæan Soc.; of the Pathological Soc.; of the Medical Society of London, vol. iv, 1878; in the Lancet for March; in Nature of the same month, and in the Popular Science Review for April, 1878; in an Introduction and Appendix to a paper (by various authors)

pub. in the Journal of the Quekett Microscopical Club for May, 1880, p. 58; and in various other papers quoted in my Parasites, Bibliog., No. 23 (p. 202), and in Appendix (p. 488) Lond., 1879; see also a paper On Filariæ and other Parasites in relation to Epidemics and Epizootics, rep. by the Epidemiological Soc. in Med. Times and Gazette for Jan. 14th, 1882, p. 64; Corre, Rev. des Sci. Nat., Sept., 1872; Crevaux, De l'hématurie chyleuse, &c., Paris, 1872; in L'Union Méd., 1872; in Arch. de Méd. Nav., 1874; in Journ. de l'Anat. et de la Physiol., 1875; Conto, A., These de Concourso, Bahia, 1872; Silva-Lima (with Crevaux), Mem. sobre a hematuria chylosa ou gordurosa (Bahia, 1876); in Gaz. Med. da Bahia, Sept., 1877, and in the Lancet for March, 1878; also in the Quekett Journal, 1880, p. 58, and in the Memoirs by Araujo and Le Roy de Méricourt, quoted below; Leuckart, Die Mensch. Par., Bd. ii, 1876; Foncervines, in Robin's Leçons, 1875; O'Neill, on Craw-craw, in Lancet, Feb., 1875; Lewis, on a Hæmatozoon in Human Blood, in Gov. Rep. for 1872, and separately (Calcutta, 1874), in Indian Annals, 1873, in Med. Press, 1873, in Lond. Med. Record (rep. by me), 1873, in Nature, 1873, and in

his memoir on the Path. Significance of the Nematode Hæmatozoa, Calcutta, 1874; see also Lewis's recent Remarks regarding the Hæmatozoa found in the Stomach of Culex Mosquito, in Proceed. of the Asiatic Society of Bengal, for March, 1878 (p. 89); especially also Microscopic Organisms found in the Blood of Man and Animals and their relation to Disease, Calcutta, 1879; Manson, Report on Hæmatozoa, in the 6th part of the Customs Gazette, Shanghae, 1877, and rep. in Med. Times and Gazette, also additional cases in M. T. and G. for March, 1878, also (in a joint communication with me) in Rep. of the Proceedings of the Med. Soc. of London, vol. iv, 1873-1879, and in the Lancet, March 30th, 1878; in Proceed. Linnæan Society, 1878, in Nature, 1878, p. 439; also further observations in Customs Gazette, 1878, and in Med. Times and Gazette for Dec. 1878, p. 731, and additional notes in Customs Gaz., 1879; see also a paper entitled Observations on Filaria, by Drs. Manson, J. R. Somerville, J. Bancroft, J. F. da Silva-Lima, J. L. Paterson, P. A. de Magalhães, and J. Mortimer Granville (with an Introduction by myself), in the Journal of the Quekett Microsc. Club for May, 1880, p. 58; also a paper on

Micro-filariæ in the same journal for August, 1880, and on the Periodicity of Filarial Migrations, in the same periodical for July, 1881 (with a chart); see also his letter to the Lancet (On *Filaria s. h.* in relation to Fever) for Feb., 1882, p. 289; a paper entitled Additional Notes (from MSS. sent to me) appeared in the Lancet for Jan. 1st, 1881, and five months later in the Med. Times and Gaz. for June 4th, 1881, p. 615 (from Customs Gazette); Sonsino, Richerche intorno, &c., in Rend. della R. Accad. di Napoli, 1874, and in Arch. Gén. de Méd., June, 1876; also remarks on the Characters of the Embryos of Filariæ in his paper on Anchylostoma, Imparziale, 1878; Magalhães, P. S. de, in Gaz. M. da Bahia, 1877, and in O Progresso Medico for Dec., 1877; in O Prog. Med., 1878, p. 577; *ibid.*, 1878, p. 589; in Gaz. Med. da Bahia for May, 1879, p. 223, for July, 1879, p. 310, and for Decemb., 1879; Bourel-Roncière, in Arch. de Méd. Navale, March, 1878, (see Araujo); Le Roy de Méricourt, in Appendix to Nouvelle phase de la question relative a la nature parasitaire de la chylurie (Découverte du représentant adulte de la Filaire de Wucherer), being a translation of Silva-Lima's memoir, quoted above (Arch. de

Méd. Navale, Dec., 1877). See also translations, with additions, in the Veterinarian for Feb., 1878; Bancroft, J., Cases of Filarious Disease, in Path. Soc. Trans. for 1878, p. 407; Chassaniol, A. (and F. Guiot), Hématurie graisseuse ou chyleuse, in Arch. de Méd Navale, 1878, p. 65; Cosse, Sur l'helminthe rencontré par Wucherer et Crevaux, &c., Rev. Montpellier, tom. i, p. 190; Ghaleb, O., in Comptes Rendus, Feb., 1877; Makuna, Filaria in Chyluria, Lancet, 1879, p. 286; Sousa, M. de A., Mem. sobre a Elephantiasis do Escroto, Bahia, 1878; Araujo, A. J. P. da S., Memoria sobre a Filariose, &c., (Bahia, 1875); see also Bourel-Roncière's Analysis of and Commentary upon the Writings of Silva-Lima and Silva Araujo, in Archives de Méd. Navale, 1875; also in remarks prefixed to his paper, entitled Tratamento da Elephancia; Caso de Chyluria, &c., Gazeta Med. da Bahia, for Oct., 1879; see also other memoirs quoted in my Parasites (p. 488), Lond. 1879; Paterson, Dr. J. L., Ainda o evolucro da fil. sang. hom., in Gazeta Med. da Bahia, June, 1879; Facts in Filariasis, in the Veterinarian for June, 1879; Abbe, Dr. R., On Chyluria, &c., New York Med. Journ., Feb., 1880, p. 129; Coles, On Lymph Scrotum, Brit. Med. Journ. for

March, 1879; Fayrer, Sir J., On Elephantiasis, Lancet, 1879, p. 433; in Med. Times and Gaz., Dec., 1877, p. 588; see a paper on the Relation of *Filaria s. h.* to Endemic Diseases of India (in the above journals for 1879), and also in La Clinica Veterinaria for March, 1880, p. 115; Santos, F. dos, in Gaz. Med. da Bahia for March, 1877; Moura, J. de, Thèse de Concours, 1877; Myers, Dr. W., Observations on *Filaria sanguinis hominis* in South Formosa, from Customs Gazette, in Med. Times and Gazette for Jan. 7th, 1882, p. 9; see also remarks by myself, in a paper rep. in Lancet for Jan. 14th, 1882, p. 64; Mackenzie, Dr. S., in Lancet, 1881, vol. ii, p. 722, and in 1882, vol. i, p. 836; also in Brit. Med. Journ., May, 1882, p. 740; Sonsino, in Lancet for May, 1882, p. 825.

Considering the importance of the new parasite (*Filaria Bancrofti*), I thought it advisable to devote more space than usual to its literature.

The human strongyloids are all of them well defined species, and they play almost as important a *rôle* in the production of endemic disorders as do the Filariæ themselves. In a general sense, the Guinea-worm may be spoken of as a Filaria, but, for reasons given in my introductory treatise and elsewhere, I prefer to consider this parasite as

the type of an osculant genus (*Dracunculus*). The nematoids placed by helminthologists under the genera *Sclerostoma, Anchylostoma, Dochmius,* and so forth, are all of them closely related to the *Strongyli* properly so called.

33. **Filaria lentis,** Diesing.

Syn.—*Filaria oculi,* Owen; *F. oculi-humani,* Von Nordmann.

Remarks.—This small worm was originally discovered in a case of lenticular cataract, under the professional care of the distinguished oculist Von Gräfe. Similar cases have also been recorded by Jüngken and Sichel, by Gescheidt and Von Ammon, and by M. Fano. There is no certain evidence as to the sexual maturity of the worms obtained in these cases, although in one instance the parasite measured three quarters of an inch in length.

Lit.—The standard works of Leuckart (l. c., Bd. ii, S. 622), and Davaine (l. c. deuxième edit., p. 831), and in my Entozoa (p. 332).

34. **Filaria labialis,** Pane.

Syn.—None.

Remarks.—The original description of this species was based upon the "find" of a medical student at Naples. The worm (of which the female only is known) was an inch

and a quarter in length, and occupied a pustular cavity in the upper lip. .

Lit.—Quoted by Leuckart (s. 616) and Davaine (Synops., c, vii), from Pane's Nota di un elminte nematoide, in Annali dell. Accad. degli aspirante Naturaliste, Napoli, 1864, (ser. 3 vol. iv).

35. **Filaria hominis oris,** Leidy.

Syn.—None.

Remarks.—This apparently sexually immature worm was described by Prof. Leidy, from a specimen preserved in alcohol, and labelled as having been obtained from the mouth of a child. It measured five and a half inches in length.

Lit.—Leidy, J., in Proceed. Philad. Acad. Nat. Sci. for 1850 (p. 117).

36. **Filaria trachealis,** Bristowe.

Syn.—*Nematoideum tracheale,* Bristowe and Rainey.

Remarks.—Minute worms, each measuring about $\frac{1}{30}$th of an inch, were found by Rainey in the trachea and larynx (post mortem). The mature condition is unknown.

Lit.—Bristowe and Rainey, in the Path. Soc. Trans for 1855.

37. **Filaria Loa,** Guyot.

Syn.—*F. oculi,* Gervais and Van Beneden; *F.*

lacrymalis, Dubini; *F. medinensis*, Gmelin; *Dracunculus oculi*, Diesing; *D. Loa*, Cobbold.

Remarks.—This worm is found beneath the conjunctiva of negroes. It is rather more than one inch and a quarter in length, being particularly abundant in the Gaboon region of Western Africa. It has also been seen in Brazil and other countries. When the worm voluntarily quits the eye a natural cure of the disease is produced.

Lit.—Fully noticed in the standard works of Leuckart, Küchenmeister, Davaine, Moquin-Tandon, and especially Gervais and Van Beneden. The descriptions are chiefly taken from the writings of Lestrille, Guyot, and Arrachart.

38. **Dracunculus medinensis**, Cobbold.

Syn.—*Filaria dracunculus*, Bremser, *F. medinensis*, Gmelin; *Dracunculus*, Lister; *D. Persarum*, Kaempfer; *Furia*, Modeer; *Gordius*, Linnæus; *Vermis*, Grundler.

Int. Host.—The Russian traveller and helminthologist, Fedschenko, discovered that small freshwater crustaceans, of the genus *Cyclops*, harbour the larvæ of the Guinea-worm. In the free embryo stage these larvæ perforate the abdominal segments, and thence proceed

to coil themselves within the limbs of the crustacean bearer.

Remarks.—The Guinea-worm disease, so common in India and other Oriental countries, is undoubtedly the same disease as the dracontiasis of Plutarch. It corresponds also with the Israelitish endemic affection described by Moses as due to fiery serpents. Küchenmeister's learned historical narrative leaves no room for doubt on this point. The older writers frequently confounded nematoid worms with serpents. As regards the mode of infection, there can be little doubt that the advanced larvæ of Dracunculus are swallowed with potable waters, and thus pass into the human stomach. Thence the female worms migrate to the surface of the body, in which situation they rapidly grow to maturity. The female parasite in its sexually mature state has been very fully anatomised by Professor Bastian. The embryos have likewise been carefully studied by Bastian, Busk, Carter, Fedschenko, Leuckart, Robin, Davaine, Lewis, and myself.

Lit.—All standard works, especially that of Leuckart, which offers an admirable *résumé* of the whole subject, including an exhaustive summary of Fedschenko's writings. Extensive literary references are given in Davaine's

well-known work, and also in the Bibliography appended to my introductory treatise.

The few nematoid parasites that remain to be considered comprise several rare and interesting species, and likewise two of the commonest intestinal worms. What I have incidentally advanced respecting the strange way in which the old writers confounded Guinea-worms with little serpents, finds noteworthy confirmation in the circumstance that the great strongyloid kidney-worm has also been looked upon as a species of venomous ophidian. Facts of this order, if duly weighed, inevitably cause us to modify our interpretation of the statements made in ancient records. Thus, to return to the Guinea-worm. Whatever good the theosophical remedies recommended and enforced by Moses may have accomplished for the human victims suffering from the attacks of "fiery serpents," or Dracunculi, it is to be feared that no similar remedial measures of the mystical kind could be rendered available in the case of animals bitten by parasites that have been regarded as renal serpents. It is fortunate, indeed, for man that the great kidney-worm (*Eustrongylus gigas*) has only once been detected in the human body. If this formidable entozoon, capable of attaining a length of three feet, were as common in man as it is in certain animals, no doubt the superstitious people of southern climes would

readily invoke clerical aid in view of obtaining miraculous cures. Possibly a mitigation of their sufferings may follow such exhibitions of human sympathy and trust. The case of animals, however, is very different. The unfortunate wolves of the Pyrenees cannot, of course, be expected to secure any very large amount of sympathy; nevertheless, it is the business and duty of the helminthologist to point to the causes of the sufferings of all kinds of animals, whether wild or domesticated, and so far as lies in his power to suggest the means whereby their sufferings may be mitigated. Not only do solitary and large nematoid parasites take up their abode in essentially vital organs of the body, and thus secure the slow destruction of the host, but the minutest forms of the same group of entozoa frequently occur in sufficiently prodigious numbers to sweep off their victims by hundreds or even by thousands. Animal epizoötics due to nematoids have hitherto been little studied.

39. **Eustrongylus gigas,** Diesing.

Syn.—*Strongylus gigas,* Rudolphi; *Ascaris renalis,* Gmelin; *Lumbricus in renibus,* Blasius; *Fusaria,* Zeder.

Larvæ.—The embryos are vermiform, and measure about the $\frac{1}{100}$th of an inch in length. In their higher larval state they have been recognised as Filariæ (*F. cystica*).

Int. Host.—From the anatomical observations of Schneider and Leuckart, it would seem that the immature worms dwell chiefly in freshwater fishes. Thus, the so-called *Filaria cystica* must be regarded as an immature *Eustrongylus gigas*. Hitherto, this little worm has been found occupying cysts or capsules, situated immediately beneath the peritoneal membrane, in *Galaxias scriba*, and in certain oceanic fishes belonging to the genus *Synbranchus*. According to the eminent piscicologist, Müller, the *Galaxiidæ* present strong affinities to the *Salmonidæ*, but Cuvier considered them as essentially modified pikes (*Esocidæ*).

Exp.—Balbiani attempted to rear *Eustrongyli* by direct experiment. He administered the ova to dogs, but obtained only negative results. Similarly, his experiments on reptiles and fishes failed.

Remarks.—If the conclusions of Schneider and Leuckart be correct—and these make it appear that we must hold certain freshwater fishes as responsible media of infection—one can only express surprise that man is so seldom victimised by this parasite. The *Synbranchi*, being tropical fishes, can have little part in the infection of animals—apart from seals. One must suppose that pumas, dogs, wolves,

gluttons, raccoons, minks, weasels, and other carnivora contract this worm by attacking, capturing, and devouring fishes at times when they are prevented from obtaining other and more readily accessible kinds of food. How this parasite should in some instances gain access to herbivorous animals is not so clear.

Lit. — All standard works, and especially Leuckart's. One of the most remarkable memoirs quoted by Davaine is that of Clamorgan. In this old writer's work, La Chasse de Loup, dated 1583, the kidney-worms, or Eustrongyli of modern writers are characterised as "serpents and highly venomous beasts."

40.—**Strongylus bronchialis,** Cobbold.

Syn. — *Strongylus longevaginatus,* Diesing; *Filaria bronchialis,* Rudolphi; *Hamularia,* Treutler.

Larvæ.—Unknown.

Remarks.—This small viviparous entozoon, hitherto only twice encountered in the human body, is doubtless identical with *Strongylus longevaginatus.* The original specimen was discovered by Treutler in Germany, in 1791, the second being found by Dr. Jortsits, in Transylvania, many years

afterwards (1845). The males measure half an inch and the females rather more than an inch in length.

41.—**Dochmius duodenalis,** Leuckart.

Syn.—*Dochmius anchylostomum,* Molin; *Anchylostoma duodenale,* Dubini; *Strongylus quadridentatus,* Von Siebold; *Sclerostoma,* Cobbold.

Larvæ.—Although the history of the development of the young worms has not actually been ascertained, it is tolerably certain that the structural characters they exhibit, and the changes they undergo, are similar to those of other closely allied species. Thus, without doubt, the free embryos are rhabditiform, and pass their larval lifetime in water, mud, and moist earth. After having undergone one or more changes of skin, attended with growth, they are possibly transferred to the human stomach.

Int. Host.—It is not certain that any intermediary bearer is necessary.

Remarks.—Water drinkers in tropical climates readily become the victims of this parasite, either by swallowing the free swimming larvæ or water insects containing the larvæ in a state of rest. The *Dochmius duodenalis* was discovered by Dubini, at Milan, in

1838, and its clinical importance in relation to the so-called Egyptian chlorosis was first announced by Griesinger. We now know that this destructive little parasite is a fertile cause of the wasting disorders of tropical countries generally, the affections termed *tropical anæmia* or *hypoæmia* being especially prevalent in the West Indies, in Cayenne, in Brazil, in Egypt, and in the Comoren Islands lying to the north-east of Madagascar. According to Prof. McConnell, the worm is also prevalent in India. The worms are veritable bloodsuckers, behaving like leeches; probably, however, the loss of strength and diminution of vital power which they occasion is not so much due to the actual amount of blood abstracted as to the severe irritation resulting from the injuries they inflict upon the mucous membrane of the infested intestine.

Lit.—The work of Leuckart; and especially a memoir by Wucherer in Deutsches Archiv fur Klinische Medicin, Sept. 27th, 1872 (S. 379-400). Amongst the more recent writings of importance are those of Perroncito in the Transactions of the Lincei Academy (1880), and of Bugnion in the Revue Méd. de la Suisse Romande (1881). See also papers by Grassi (Gaz. Med. Ital.-

Lombard, 1878); by Bozzolo (Giornale intern. delle Sc. Mediche, 1879); by Bäumler (Corresp.-Blatt für Schweiz. Aerzte, 1881); and by Mégnin in Comptes Rendus Hebd. des Sc. de la Soc. de Biologie for March 10th, 1882, p. 172. A brief notice of McConnell's discovery of the St. Gothard Anchylostome or Dochmius in India appeared in the Lancet for April 1st, 1882, p. 529. See also the Times art. on 'Tunnel Trichinosis' (*sic*), for March 20th, 1880. It may be added that complete summaries of the literature of this subject are given in the work of M. Fabre (De l'anémie, &c., Paris, 1878), and in the well illustrated brochure of Dr. Bugnion above quoted.

Eight more nematodes remain to be noticed. Of these, two are excessively common in man, and a third, though rare as a human parasite, is very abundant in carnivorous animals. The three entozoa thus particularised are popularly known as the threadworm, the lumbricus, and the cat's worm. The threadworm is just one of those species about which one does not like to say very much in public; and even that which is whispered about these entozoa in consulting rooms has to be conveyed to the victim's ears with tact and delicacy. I will mention an illustrative case. An unmarried gentleman,

the happiness of whose immediate future was intimately bound up with his speedy restoration to health, freely communicated to me the painful nature of his sufferings due to the presence of these little parasites. The symptoms need not be stated in detail. Let it suffice to say that the obnoxious guests had invaded the host by myriads, bringing their victim down to an emaciated and otherwise pitiable condition. Knowing the essential conditions of infection, I ventured to hint that the victim must in some way or other have swallowed one or more entire female parasites of this species (*Oxyuris vermicularis*). The suggestion was a hard though happy hit; for it speedily brought the confession that in times of great distress the victim had, *en revanche*, seized hold of the living parasites and crushed them between his teeth. As, without doubt, most, if not all, of the entozoa thus bitten in halves were female worms; and as, moreover, each female parasite enclosed myriads of eggs—whose contained embryos do not require a change of hosts —it is certain that thousands, not to say tens of thousands, of living germs were thus directly conveyed to the human territory. In this way the victim, originally seeking to revenge himself on the sexually mature parasites, could only have produced momentary pangs in the worms themselves, but for himself, he had thus unwittingly prepared that far more terrible and prolonged revenge which

was afterwards exercised, unconsciously, by the progenies of the parent worms thus mutilated.

42. **Oxyuris vermicularis**, Bremser.

Syn.—*Ascaris vermicularis*, Linnæus.

Larvæ.—Only generally known in the embryonic state. Whilst within the egg they are at first tadpole-shaped, but under suitable conditions of heat and moisture they rapidly assume a vermiform character.

Int. Host.—Not required.

Exp.—Leuckart reared intra-ovular vermiform embryos by placing the eggs in moistened paper envelopes and exposing them to the action of the sun's rays. Heller reared them in glass tubes filled with saliva and carried about under the arm-pits. Heller and Zenker possessed themselves of specimens of the higher larvæ from the small intestines (post mortem) in a case where the patient had swallowed the eggs some days previous to his death. I caused a monkey to swallow a quantity of eggs in the hope of rearing the adult parasites, but the result proved negative. Possibly at the post-mortem examination I overlooked the existence of larvæ, but I do not think any were present. Lest some persons should suppose this kind of experimentation to be

unwarrantable, I may remark that it had for its object the alleviation of human suffering. Others have experimented upon themselves with the same benevolent purpose. Thus, Professor Leuckart and three of his pupils infested themselves by courageously swallowing a quantity of the ova. They certainly enjoyed the satisfaction of subsequently supplying ocular proof of the success of their worm-feedings.

Remarks.—The common notion that these parasites breed within the human body is an error, and it is equally incorrect to say that they reside in the lowermost part of the intestinal canal. Their headquarters are the cæcum and upper part of the colon. It is true that Vix and Leuckart have noticed embryos within the large intestine; but Leuckart, Heller, and myself alike regard this intestinal hatching as an unusual occurrence. For the purposes of infection it is alone necessary that the eggs of the worm be conveyed to the mouth and swallowed. Their previous immersion in water for any length of time secures their destruction, by the bursting of the egg shells consequent upon endosmosis. The eggs are conveyed to the mouth in various ways. Ordinarily, children become infested by biting their

nails, beneath the margins of which the eggs lie concealed. Professors Heller, Zenker, and myself have, all more or less, frequently had occasion to demonstrate this fact to our patients. Occasionally, the eggs are swallowed by accident during sleep. Still more rarely whole parasites may be conveyed to the mouth in a similar manner. In whatever manner they may have been conveyed to the bearer, when once the eggs have gained access to the stomach, their shells are dissolved by the action of the gastric juice, and the larvæ are liberated. In the upper intestine the larvæ grow rapidly. Here they undergo one or more changes of skin; acquiring sexual maturity within a period of less than a month.

Lit.—All standard works. See also my lectures on Helminthology (Worms), and more particularly the admirable article (Darmschmarotzer) by Heller, in Von Ziemssen's Handbuch, or the recently issued American edition of the same work. Also Heller's popular manual Die Schmarotzer, 1880, S. 65.

43. **Leptodera stercoralis,** Bavay.

Syn.—*Anguillula* (*Rhabditis*) *stercoralis,* Bavay; *Pseudo-rhabditis,* Perroncito.

Larvæ.—These are at first known as minute embryos, measuring only $\frac{1}{250}$th of an inch in length. Subsequently, in the condition of immature rhabditiform larvæ, they acquire a length of about $\frac{1}{80}$th of an inch. All their changes of size and shape, accompanied by ecdysis, are undergone within the human intestine. Under favorable circumstances five days are fully sufficient for the complete development and maturation of the parasite.

Int. Host.—Not necessary.

Exp.—None.

Remarks.—In the full grown state this little nematode is stated to be only the $\frac{1}{25}$th of an inch in length. It was discovered by Dr. Normand in excrements passed by French soldiers suffering from the so-called Cochin China diarrhœa. They had been sent home as invalids. This entozoon, by its injurious action, supplies another remarkable instance of parasitism as a cause of endemic disease. Drs. Normand and Bavay state that the victims are infested to such an extent that the number of little worms present in severe cases can only be adequately estimated at many hundreds of thousands. Their extreme rapidity of growth and maturation readily account for this excessive degree of infection, which is maintained with much

persistence, in spite of the dysenteric action which daily expels myriads of the parasites in every stage of development. I may add that post-mortem inspection has shown that the anguillules not only occupy all parts of the alimentary canal, from the stomach downwards, but that they also find their way into the pancreatic and biliary ducts, and even into the gall-bladder.

Lit.—Normand (Dr. A.); Mémoire sur la diarrhée dite de Cochin-chine, in Archives de Médicine Navale for January, 1877, and especially his recent article Du Role Etiologique de l'Anguillule, *ibid.*, September, 1878, Bavay; in Comptes Rendus for October, 1876; Perroncito, in Robin's Journal, 1881, and in Roy. Micr. Soc. Journ., for April, 1882, p. 191.

44. **Leptodera intestinalis**, Bavay.

Syn.—*Anguillula*(*Rhabditis*)*intestinalis*, Bavay.

Larvæ.—Similar to those of *Leptodera stercoralis*, but relatively larger, and possessing a remarkably long œsophagus, together with a blunt instead of a sharply pointed tail.

Int. Host.—Not necessary.

Exp.—None.

Remarks.—The full grown worm is almost three times the length of the preceding

species. In the Cochin China victims it is frequently, though by no means invariably, associated with its smaller and far more abundant congener. In consequence of its occurring in comparatively small numbers, it is not easy to state to what extent this worm is concerned in the production of disease. Were it as abundant as *Leptodera stercoralis*, it would doubtless prove more destructive to the human bearer.

Lit.—Bavay; Note sur l'Anguillule intestinale; in the Archives de Méd. Navale for July, 1877.

45. **Leptodera teres**, Schneider.

Syn.—*Rhabditis Cornwalli*, Cobbold; *Pelodera setigera*, Bastian.

Remarks.—A few years ago the not uninteresting discovery of the occurrence of this entozoon (in the muscles of a lad who had died of fever) was made by Mr. W. H. Power. Unfortunately, through the want of elementary helminthological knowledge, some persons placed a false interpretation upon the find. The case was announced as one of Trichinosis. Parliament itself was aroused, and questions were asked in both houses. After much delay, the Medical Department issued (on March 15th, 1880) Mr. W. H.

Power's "Report to the Local Government Board on an Outbreak of Fever that proved to be Trichinosis on board the Reformatory School Ship 'Cornwall.'" Of course, it proved to be nothing of the kind. I pointed this out in a public lecture published in the Sanitary Record, and in the Times. As subsequently stated by me, in the Quekett Journal, "not a single Trichina was found in any case, not even in the exhumed body, and moreover, the symptoms did not correspond with those of Trichinosis." I pointed out that many other small parasites had already been falsely described as Trichinæ, and this was clearly only another instance of the same kind. The parasites were rhabditiform, and on the basis of Mr. Power's facts and illustrations I suggested that the parasite should be called *Rhabditis Cornwalli*. Subsequently Dr. Bastian, who also thought the worm was new to science, called it *Leptodera setigera*; but it remained for Dr. L. Oerley, the Hungarian helminthologist, to point out that the nematoid had already been described and figured by Schneider under the name above given. Dr. Oerley obtained this worm from earth near the River Thames; and as this worm has hitherto been known only as a free nematoid, its mode of entrance into the

body of the lad becomes a matter of speculation. Considering that two months had elapsed before the exhumation was made, and considering also that the parasites (spoken of as "wandering and living Trichinæ") showed no indication of attempted capsulation, I have very little doubt but that the parasitism was itself a mere post-mortem result. Here was, indeed, a human body swarming with worms after death. Thus, if my interpretation of the facts be correct, Mr. Power's apparent surprise that the parasites should have "altogether resisted decomposition" need not now occasion our astonishment. Anyhow, the results of the exhumation are both interesting and instructive. The position which I held from the first proved to be correct. Articles directed against my views were written to screen and modify the palpable error of the Government Report. For myself this experience was nothing new; but unfortunately the professional public in England having been thus misled, an American periodical (New York Med. Record for June 10th, 1880, p. 600) soon after followed suit, and quoted the "Cornwall outbreak" as a genuine instance of Trichinosis. Error being more easily propagated than truth, this false interpretation will

probably remain acceptable for many years to come. A vast number of minute parasites and parasitic diseases have already been described as instances of Trichinæ and Trichinosis respectively; and thus a practically endless confusion of terms has been needlessly introduced. In several directions I have sought to expose the folly of these misinterpretations, and I am glad to see M. Mégnin and Dr. Lewis have been contributing to the same end. When the microfilarial infection of crows is described by Borell as a form of Trichinosis, absurdity can go no further, and one feels inclined to ask why young professional investigators omit to acquaint themselves with results already obtained before they announce their discoveries.

Lit.—Power, W. H., Report (above quoted), 1880; Cobbold in Journal of the Quekett Microscopical Club, August, 1880, p. 148; also in the Sanitary Record for May, 1880 (p. 407), and June (p. 449); in Osservatore (1880), and in L'Italia Agricola (December 15th and 23rd, 1880). See also the remarkable article in the Lancet, entitled Trichinosis and Trichinosis (May 8th, 1880, p. 735), in which my letter to the Times (May 3rd, 1880) is denounced with refreshing vigour. See

also the Trichinosis Scare, being an article in Med. Press and Circular for April 7th, 1880, p. 289, and the Medico-Parliamentary Report in British Medical Journal for March 27th, 1880, p. 497.

46. **Rhabditis genitalis,** Schreiber.

Syn.—None.

Remarks.—Mature and immature worms were discovered in the urine of a female. The male worm is about one millimètre in length, the immature parasites being only one-fourth or one-fifth of that length, that is, from the $\frac{1}{125}$th to the $\frac{1}{100}$th of an inch.

Lit.—Lancet, June 18th, 1881, p. 1004. On the general subject of the Rhabditidæ and Rhabditoid larvæ, see especially Dr. Oerley's Report in the Annals and Mag. of Nat. Hist. for April, 1882, p. 301, *et seq.*

We now pass to the consideration of the Ascarides properly so-called. Medical practitioners, indeed, frequently speak of the threadworms as Ascarides, and they also call the large roundworms Lumbrici. Both terms are erroneous and equally misleading. The threadworms or Oxyurides have a spindle-shaped body and finely drawn-out tail. Hence their generic name. The large roundworms, apart from their external resemblance to earthworms, have nothing in common with them. The earthworms or

Lumbrici are oligochætous Terricolæ and hermaphrodites. Human roundworms are unisexual. In the minds of unscientific persons these parasites are often mistaken for earthworms, and even also for serpents and eels. In newspapers we occasionally read of living eels ejected from the mouth, and thus it is that the undisciplined mind, incapable of correct observation, still conjures up and gives expression to notions which are just as absurd and untrustworthy as are many of the statements made in ancient writings, both sacred and secular.

47. **Ascaris lumbricoides,** Linnæus.

Syn.—*Fusaria,* Zeder; *Lumbricus teres hominis,* Tyson.

Larvæ.—As embryos in the egg they measure about $\frac{1}{100}$th of an inch in length. Heller found immature worms post-mortem, of from $\frac{1}{9}$th to $\frac{1}{2}$ an inch in length.

Int. Host.—Probably not necessary.

Exp.—Davaine, myself, and others have frequently reared the embryos in water; and whilst still enclosed within the eggshell the embryos have been kept alive by Davaine for five or more years. The administration of eggs, by Leuckart, to swine, dogs, rabbits, and mice, gave only negative results. Davaine also employed eggs, containing the embryos, in a similar set of experiments on rats and

dogs. He also introduced them into the stomach of a cow, in linen-covered flasks. Some embryos escaped their shells, but nothing further transpired. Leuckart's experiments on insects also failed. Numerous worm-feedings with allied species of Ascaris have given similar general results at the hands of Leuckart, Davaine, Verloren, Unterberger, and myself. Heller says that the first moult of the larva occurs within the egg itself, a second ecdysis taking place before the worm arrives at sexual maturity.

Remarks.—There is every reason to believe that infection commonly occurs by persons carelessly drinking water into which the eggs of the worm have been accidentally or otherwise introduced, and within which medium the embryos have been hatched during warm weather. Pigs being infested by the same worm, the water from streams or ponds in the neighbourhood of pigsties becomes a dangerous source of infection when employed for domestic purposes. Local endemics are traceable to this source. Careful filtration of water containing larvæ, before use, would probably of itself be an amply sufficient safeguard against infection. The determination of the identity of Dujardin's so-called *Ascaris suilla* of the hog with *A.*

lumbricoides of man is due to Schneider. The large lumbricoid worm of the horse (*A. megalocephala*) is an entirely distinct species. In consequence of the tendency of lumbricoid worms to wander, they frequently give rise to grave symptoms and severe suffering to the human bearer; and they occasionally cause death by perforating the walls of the intestine. This fact implies the possession of great muscular strength. In the year 1863, Mr. Hughes read a paper to the Birmingham Natural History Association, in which he described the remarkable contractile powers of *Ascaris lumbricoides*. Mr. Hughes and Mr. C. J. Bracey (House Surgeon to the General Hospital), acting together, placed living specimens of the worms in water, raised to a temperature of about 100° Fahrenheit. This had the effect of keeping the parasites alive for several hours, during which time they displayed remarkably vigorous movements, their bodies contracting violently.

Lit.—Standard Works. See also Heller (loc. cit., and in Midland Naturalist, vol. ii, p. 8). In connection with sanitary questions, I may refer to my memoir On Sewage and Parasites, especially in relation to the dispersion and vitality of the germs of Entozoa,

in the Medical Times and Gazette for Feb. 25th, 1871, p. 215, *et seq.*

48. **Ascaris mystax**, Rudolphi.

Syn.—*Ascaris alata*, Bellingham; *A. cati*, Schrank; *A. teres felis*, Goeze.

Larvæ.—As intra-ovular embryos, the early stages are developed whilst the eggs are still within the body of the parent female worm. After hatching, and a subsequent residence in the outer world, so to say, their passive transference to the ultimate host is attended with rapid growth and a final ecdysis. Leuckart has traced these stages of growth in the cat, in whose stomach specimens of the larvæ were found measuring only $\frac{1}{62}$ of an inch. The final skin is cast when the larvæ are about $\frac{1}{3}$ of an inch long. From Hering's observations, it would seem probable that a period of three weeks is amply sufficient for the production of sexual maturity after the larvæ have gained access to the body of the ultimate bearer. The bearer may be either man himself, or it may be a cat, dog, lion, or some other feline carnivore.

Int. Host.—Not necessary.

Exp.—Leuckart and others have made direct feeding-experiments with the ova, but they have always been attended with negative results.

Remarks.—The determination of the identity of this worm with Bellingham's *Ascaris alata* rests with myself. In this matter I had to oppose the great authority of my respected friend and senior, Professor Leuckart, and I had also to overcome the opposition of Küchenmeister, who sought to throw doubt on Bellingham's original discovery, characterising the so-called *Ascaris alata* as merely a young worm, "if indeed," he added, "it were a worm at all." At length, due acknowledgment of the correctness of my views has been made; and no less than seven instances are now on record of the occurrence of this parasite within the human body. Historically, this entozoon possesses a special interest in the fact that it supplied Dr. Henry Nelson with the data on which his remarkable thesis was based. In this thesis an important advance was made in reference to our knowledge of the embryogenetic process undergone by the nematodes.

Lit.—Bellingham, Dublin Journal, 1839; Nelson, Phil. Trans., 1851–52; Heller (l. c., S. 361); Cobbold, Lancet for January, 1863, and in Entozoa, p. 316, *et seq.*

49. **Ascaris maritima,** Leuckart.

Syn.—None.

Larvæ.—Unknown.

Exp.—None.

Remarks.—A solitary sexually immature specimen supplied Leuckart with the means of determining the existence of this worm as a distinct species. It measured about one inch and three quarters in length. The specimen was discovered in April, 1865, by Dr. Pfaff, at Jacobshavn, near Godhavn, West Greenland. It had been ejected from the mouth by a child.

Lit.—Leuckart, Die menschlichen Parasiten, Bd. ii, S. 877.

ACANTHOCEPHALA.

The thorn-headed worms play a very insignificant *rôle* in human parasitism, and I think that the solitary instance of infection from this source must be regarded as accidental. Considering the character and habits of the intermediary host which harbours the larva of the only species yet alleged to have been found in man, it is even surprising that one case of parasitism of the kind in question should have occurred.

50. **Echinorhynchus gigas**, Goeze.

Syn.—*Echinorhynchus hominis*, Lambl; possibly *Echin. angustatus* or *E. spirula* according to Leuckart; *Tænia*, Pallas; *Ascaris*, Frisch.

Larvæ.—As embryos they are taken (whilst still within the egg) into the bodies of cockchafer-maggots, where, after hatching, they undergo metamorphoses attended with growth.

Int. Host.—This was determined by Schneider to be the larva of the common cockchafer (*Melolontha vulgaris*).

Exp.—Leuckart succeeded in infecting small crustaceans by introducing the eggs of *Echinorhynchus proteus* into fresh water containing living *Gammari* (*G. pulex*). The eggs were swallowed by the unsuspecting crustaceans. Similarly, maggots of cockchafers accidentally swallow the ova (of *Ech. gigas*) which have been dropped either in pigsties or amongst refuse on muck-heaps, dung-hills, in farmyards, or in open fields frequented by hogs.

Remarks.—The only genuine instance on record of the occurrence of this parasite (assuming it to be *Ech. gigas*) in man is the case published by Lambl. It was a young worm, measuring less than a quarter of an inch in

length, being found in the small intestine of a boy. Undoubtedly it was a true *Echinorhynchus*. A second supposed case, in which "an encysted *Echinorhynchus*" was said to have been detected in man, is recorded by Welch. Notwithstanding Professor Heller's acceptance of this case as genuine, I am confident that the *Echinorhynchus* in question is neither more nor less than a sexually immature Pentastome. As regards the adult *Echinorhynchi* of the hog, it may be added that their presence within swine proves exceedingly inconvenient to the porcine bearer, occasionally producing a fatal epizoöty. According to Verrill (in the United States), "the intestine of a hog is sometimes found perforated by so many holes that it cannot be used for the manufacture of sausages."

Lit.—Lambl, in Prager Vierteljahrschrift for February, 1859; Welch, in the Lancet for November, 1872; Schneider, in Archiv für Anat. und Physiol., 1868; Verrill, the External and Internal Parasites of Man and the Domesticated Animals, Connecticut, 1870; Heller, Darmschmarotzer (l. c., S. 664); Cobbold, Manual of the Parasites of the Domesticated Animals, 1874 (p. 123); Leuckart (l. c., Bd. ii., S. 729, *et seq.*).

SUCTORIA.

A vast number of suctorial annelids attack man in such a way as to almost deserve the title of parasites. They have been called "free parasites" by Van Beneden, an expression which looks like a contradiction of terms, but which, nevertheless, conveys a very accurate notion of their habits. In this category come the ordinary leeches, besides numerous aberrant forms of leech, some of which have only been imperfectly described. The extent and complications of the subject are so considerable that I am compelled to select for enumeration only a few of the principal species. Many of these pests victimise animals in common with man:

51. **Sanguisuga officinalis,** Savigny.

This, the green leech, occurs throughout Central and Southern Europe, and also Northern Africa.

52. **Sanguisuga medicinalis,** Savigny.

The grey leech. This has a similar geographical distribution.

53. **Sanguisuga interrupta,** Moquin-Tandon.

The dragon leech. Inhabits Barbary and Algeria.

54. **Sanguisuga tagalla,** Meyen.

The Ceylon leech, of which there are several varieties. They live in woods and damp places.

55. **Sanguisuga Javanica,** Wahlberg.

The Javanese leech. This species is probably identical with one or other of the varieties found in China, Japan, and other eastern countries.

56. **Hæmopis sanguisuga,** Moquin-Tandon.

The horse leech. Found in all parts of Europe, in Egypt, and throughout North Africa. This species often attacks man in warm climates, introducing itself into the mouth and nasal passages.

57. **Hæmenteria Ghiliana,** Filippi.

This form is tolerably common throughout Brazil.

58—59. **Hæmenteria officinalis,** and **H. Mexicana,** Filippi.

These species inhabit Mexico and Central America.

60. **Cyclobdella lumbricoides.**

The blind leech. This is another Brazilian species which attacks man and animals indiscriminately.

ARACHNIDA.

Amongst the trachearian section of this great class of arthropodous invertebrates there are numerous parasitic species which attack man and animals. They are more familiarly known as mites (*Acaridæ*), ticks (*Ixodidæ*), and Pentastomes (*Pentastomidæ*).

61. **Pentastoma tæniodes,** Rudolphi.

In the sexually incomplete state this entozoon infests the liver of man, being commonly spoken of as *Pentastoma denticulatum.* The mature form resides in the nasal chambers of the dog and other animals.

62. **Pentastoma constrictum,** Von Siebold.

Like the former species, this entozoon is found in an immature state in the human liver. It also infests the lungs.

63. **Sarcoptes scabiei,** Latreille.

The human itch insect. This common arachnidan has been described under a multitude of synonyms. According to the highest living autho-

rity, Mons. J. P. Mégnin, most of the so-called species infesting our domestic animals are mere varieties of this species.

64. **Sarcoptes crustosæ,** Fürstenburgh.

The Norway itch insect. In the view of Mégnin this is, at best, a mere variety of the common species.

65. **Tyroglyphus Méricourti,** Laboulbène.

This singular species, furnished with enormous palpi, was found by Dr. Le Roy de Méricourt on an officer who had come from Havannah.

66. **Demodex folliculorum,** Owen.

The face mite. In France about ten per cent. of the population are victimised by this disfiguring little parasite. The form infesting the dog is only a variety.

67—68. **Entarsus cancriformis,** and **Cælognathus morsitans.**

These two arachnidans appear to be genuine human parasites. They were discovered by Hessling.

69—70. **Argas persicus** and **A. chinche.**

These two arachnidans of Persia and Columbia respectively are terrible blood-suckers, the former, which is sometimes called the Miana bug, having been known to prove fatal to man.

71. **Ixodes hominis,** Koch.

This is probably identical with one or other of the ticks known to infest domesticated animals (*Ix. reduvius, Ix. ricinus, Ix. nigra,* &c.). It is certain that one or more of these forms have been found on man, occasioning severe pain.

72—73. **Ixodes monbata** and **Ix. carapato.**

These are troublesome species, the former occurring in Angola, the latter in Brazil.

74. **Galeodes araneoides.**

The camel tick. This disgusting and highly venomous species, nearly two inches in length, is very apt to attack man if disturbed.

75. **Leptus autumnalis.**

The harvest bug. This little pest attacks indiscriminately mankind, dogs, cats, rabbits, and probably also many other animals.

76. **Trombidium cinereum.**

The hexapod larva of this or some closely-allied species was found by the late Dr. Fox on a child.

77. **Gamasus.**

One or more species belonging to this genus of dung-beetle mites have been found fastened on the human body.

INSECTA.

Instances of true parasitism, partial parasitism, and the so-called "free parasitism," due to insects properly so-called, are by no means uncommon in man. Flies, bugs, fleas, and lice come under this category. Only a few forms can be here enumerated.

78. **Blaps mortisaga.**

The churchyard beetle. Many perfectly well authenticated instances of the occurrence of this insect in the human body are on record, and I have myself published an instance from facts and specimens supplied by Dr. Horne, of Barnsley. In Pickell's celebrated case, 1200 larvæ, and also several perfect insects, were passed by the bowel.

79. **Tenebrio molitor.**

The larvæ of this closely-allied species have also been occasionally found passing from the human body.

80—83. **Œstrus hominis.**

This insect, in the so-called "bot" condition,

and also several others (*Œ. Guildingii, Œ. Livingstonii, Œ. bovis*), have been found in man. I stand indebted to Sir John Kirk for a specimen removed from Dr. Livingstone's leg. I placed it in the Hunterian collection.

84. **Cuterebra noxialis.**

This is the well-known Macaco worm. It attacks man as well as animals.

85—86. **Anthomyia canicularis.**

The larvæ of this fly are quite common in man. I have myself encountered them, professionally, on six separate occasions. *A. scalaris* has also been found in the fæces.

87—93. **Musca Cæsar.**

This fly is the species which proves so troublesome to sheep. Its maggots, and also those of *M. domestica, M. stabulans, M. larvarum, M. carnaria, M. cibaria,* and *M. nigra,* have been found in the human body, playing the part of true parasites.

94. **Musca vomitoria.**

The bluebottle. One or two horrible cases of parasitism from the maggots of this fly were recorded by Sells from Jamaica. In one instance, 235 maggots were expelled from the nostril.

95. **Lucilia hominivora.**

The revolting parasitic habits of the maggots

attributed to this species almost exceed belief, but they have been amply attested and described by MM. Coquerel, Vercammer, Bouyer, and others. Not content with devouring the soft parts at the back of the mouth and nostrils, including the pharynx and glottis, they have been known to eat their way into the sockets of the eye.

96. **Helophilus pendulus.**

Two or three instances are on record of the occurrence of rat-tailed maggots infesting man, and one such instance has been brought under my notice by Mr. Noot, a former pupil of mine at the Middlesex Hospital.

97. **Stomoxys calcitrans.**

This is the well-known leg-sticker of the Germans, an excessively blood-thirsty fly.

98. **Hæmatopota pluvialis.**

The clegg of the West Highlands. It attacks indiscriminately man and beast.

99. **Culex anxifer.**

The mosquito. Probably many species of mosquito attack man as well as animals. The importance of these insects as intermediate bearers of human filariæ needs only be again alluded to.

100—103. **Chironomus plumosus.**

As examples of free parasites not only the midge,

but also many other well-known gnats, may be here enumerated. (*Culex pipiens, C. pulicaris, C. annulatus*).

104. **Simulium reptans.**

The creeping gnat. This is a very troublesome insect in Sweden.

105. **Glossina morsitans.**

The Tsetse. This notorious insect, made famous by Livingstone's account of its ravages, is terribly destructive to horses, oxen, sheep, and dogs. Its bites, however, though very annoying, do not prove fatal to man.

106. **Pangonia.**

A species of fly referred to this genus is the seroot or zimb of the traveller Bruce. Its attacks are excessively painful to the victim.

107. **Conorhinus nigrovarius.**

This insect, known as the Pampas benchucha, sucks blood like an ordinary tick. Our eminent countryman, the late Charles Darwin, has told us that in ten minutes this greedy insect, when playing the part of a parasite, "changes from being as flat as a wafer to a globular form."

108. **Acanthia lectularia.**

The bed bug. This well known insect forms a characteristic type of the so-called "free parasites."

Without attaching itself to the person, it plays the part of a true parasite by its occasional visits for the purpose of deriving sustenance.

109—110. **Acanthia rotundata** and **A. ciliata.**

These species, of Reunion Island and Kasan respectively, are said to be more blood-thirsty than the common bed bug.

111—114. **Reduvius personatus.**

This fly-bug is abundant in France, and another species (*R. amœnus*) is found in Borneo, whilst others occur in India and elsewhere (*R. serratus, R. cruentus*).

115. **Pulex penetrans.**

The jigger or chigoe. This well-known and excessively troublesome insect is particularly abundant in the West Indies and in tropical America generally. The females attack the soles of the feet, and secure a lodgment beneath the skin. They also attack animals.

116. **Pulex irritans.**

The common flea. As a rule the various species of flea limit their visits to their own proper hosts, but those of the domestic animals are said to attack man occasionally.

117—121. **Pediculus.**

Five distinct species of louse are recognised as

human parasites. These are the head louse (*P. capitis*), the clothes louse (*P. vestimenti*), the distemper louse (*P. tabescentium*), the groin or pubic louse (*P. inguinalis*), and the louse of the eyelids (*P. palpebrarum*).

The lice found on Negroes and Greenlanders are thought by some to be distinct forms. I believe the late Mr. Andrew Murray disproved this view; and his opinion as a practical entomologist may be regarded as decisive. Occasionally one or more species of bird-lice have been found on man, and they have been regarded as human parasites. This has occurred particularly in the case of *Ornithomyia avicularis*, ordinarily infesting cage birds. In like manner one or more of the numerous species of lice infesting our common barn-door fowls are apt to attach themselves to horses that are not well groomed, giving rise to that most painful form of phthiriasis, known to veterinarians under the name of poultry-lousiness.

Such is the list of human parasites, entozoal, ectozoal, and free. As far as it goes, I believe it presents a tolerably exhaustive summaryof the facts of human helminthism. I have said nothing about the protozoal parasites; for I felt that if once these were entered upon there would be practically no limit to the mere enumeration of so-called species. Doubtless the confervoid and simple organisms

known as *Bacilli, Bacteria, Spirilla, Micrococci,* and so forth, are many of them as truly parasitic as any of the higher forms of life we have noticed; moreover, many of them play an equally important part in the production of disease. Besides these, we have parasitic Monads, Psorosperms, Bursarians (*Paramecium*), and Gregarines, in addition to other forms, whose position among the Protista is far from being definitively settled.

CONCLUDING REMARKS.

The literature of the subject of microphytes has of late increased to such an extent that it would require several pages for the mere enumeration of published memoirs. As a model of the exhaustive treatment of one department, Dr. H. Vandyke Carter's work on Spirillum Fever leaves nothing to be desired. If our leading hospital physicians imagine that it is possible for any one human intellect to acquire a thorough knowledge of all that appertains to parasites, parasitic diseases, and their treatment, they must be flatly told that they greatly deceive themselves. Not only so; they must be informed that by restricting their teaching to common-place subjects, they do serious injustice to the rising generation of medical practitioners.

An insane prejudice against special knowledge has recently sprung up. Where it does not proceed from individuals who are ignorant of their own ignorance, it can only have for its object the restriction of scientific investigation and the suppression of the law of human progress. In civilised communities the working of the principle of division of labor is intimately bound up with the public welfare, and those who arrogate to themselves the possession of universal medical knowledge do great injustice to the cause of suffering humanity.

Specialisms, doubtless, like other good things, are liable to abuse, but where such developments of culture are based upon a sound antecedent education at our medical schools and universities, there need be no fear as to the general result. To rescue any department of the science of medicine from the hands of vulgar and unqualified persons demands an effort which should secure the approbation of every right-thinking member of the medical profession.

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